Sodium Titanate Anodes for Sodium Ion Batteries

One of the challenges for successful development of sodium ion batteries is identification of a suitable anode material with high capacity and good cyclability. The most promising materials for this application in the short term are likely to be intercalation compounds due to safety concerns with hard carbons and the large volume changes associated with metal alloying reactions, two alternatives currently being investigated. Our current research is focused on sodium titanate intercalation compounds for this purpose. A variety of structures can be synthesized depending on conditions, Na/Ti ratios, and the presence or absence of additional elements in the precursor mix, but most have either tunnel, stepped layered or corrugated layered structures. Because of site limitation issues with the tunnel compounds, the layered variants are of greater interest for use in batteries. Our recent work has focused on a stepped layered compound derived from dehydration of $NaTi_3O_6(OH)\bullet 2H_2O$ (also known as sodium nonatitanate), and those with lepidocrocite-type (corrugated layered) structures. Both types of materials exhibit reversible sodium and lithium ion intercalation processes at very low potentials vs. the alkali metal (~0.5V), and have gradually sloping voltage profiles indicative of solid solution processes. The theoretical capacities of these materials are high, ranging from 200-300 mAh/g depending on exact composition, making them of interest for further development for use in either sodium ion or lithium ion batteries.

Acknowledgments

This work was supported by the Laboratory Directed Research and Development Program of Lawrence Berkeley National Laboratory under U.S. Department of Energy Contract DE-AC02-05CH11231. This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.